Financing Projects That Use Clean Energy Technologies: A Summary Overview of Barriers and Opportunities

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Purpose

Articulate the major perspectives, drivers and requirements of public and private sector project financiers, venture capitalists, and entrepreneurs (collectively the "participants") relating to the financing of projects using clean and renewable energy technologies ("clean energy technologies"). Also expand the project financing dialogue among participants, while providing a robust framework for that dialogue, that will, in turn encourage other experts to participate, contribute and benefit by helping to:

- Identify key opportunities to improve the availability of financing (debt and equity) for energy technology projects.
- Identify ways public/private sector collaboration can add significant value and how collaboration between participants can be fostered at an early stage.
- Leverage, adapt, refine (from other project financing contexts), and accelerate the deployment of the project financing resources that exist today.
- Develop innovative strategies for addressing key barriers to project financing. Barriers include the inability to secure both debt and equity financing for projects that, while "commercial" in the minds of the technology developers, are seen as having too much technology performance risk by lenders.

Approach

While first providing a very brief context for project financing, we quickly focus in on a small subset of the existing project financing knowledge base[1] that has particular relevance for clean energy projects and the particular issues that such projects face. In particular we emphasize the risk and scale issues that provide both challenges and opportunities in the financing of clean energy projects.

By framing the key issues in this way and then discussing the opportunities to address these issues, we hope to stimulate productive dialogue among other experts and encourage them to provide further detail as appropriate. We offer the opportunity in particular for, and encourage, project financing experts to write brief white papers on the issues cited here, as well as other issues that emerge from our ongoing dialogue, which we will post on a dedicated web site. We already have posted a number of presentations given to us by various investors on this site.

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[1] There are many excellent published exposes on project financing that that cover the broad waterfront of this body of knowledge; e.g. see Finnerty (1996), Esty (2004), and Esty (May 8, 2003).

Defining Project Financing

In its earliest form, the concept of project financing dates back to the 17th century when wealthy Dutch and Belgian lenders financed voyages to the new world and received payment from whatever was brought back. If the ship sunk, so too did the collateral. The ship-owner did not have to repay the loan. However, if the ship returned with a huge bounty, the lender was repaid and split the profits with the ship-owner.

The modern form of project finance appeared with commercial mortgages in the 19th century when a lender took a mortgage on a commercial building and used rents to repay the loan. This technique was further modified in the late 1960's when oil and gas loans were secured with their underlying reserves, and the sale of oil and gas was used to repay the loan. Both commercial real estate and oil and gas reserve lending had one common attribute, there was almost no technology risk. But if the real estate market collapsed, or the well ran dry, the borrower did not have to repay the loan from their other properties.

In the 1970's, this principle of securing a loan with the assets of a project and using the cash flow from the project to repay the loan, became known as "project financing". During the 1980's and 1990's the concept was used for a myriad of projects including chemical plants, power plants, the Chunnel between France and the U.K. and even Euro Disney were financed with project loans.

Project finance is still evolving, with the potential for significant innovation; especially in the area of collaborative public-private financing such as the use of loan guarantees and financial options that provide price protection for plant energy output.

While project finance has many definitions, traditional project finance requires the integration of a number of common ingredients.[2] More specifically, project finance is asset based financing, meaning that the project lenders have recourse only to the "underlying assets of project". This can get complex since the "underlying assets of the project" often include contracts and guarantees from third parties. Project financing involves both debt and equity, where the debt to equity ratio is typically large (as much as 70% debt and 30% equity). Revenue from the project must be able to repay interest and principal on the debt and generate a return to the equity investors, as well as pay the transaction costs associated with developing and structuring the project (see Esty, 2004) and the Operations and Maintenance costs of the project.

Traditionally, project financing has been focused on larger scale projects - Esty (2004) defines large as greater than $500 million - where transaction costs can be more easily absorbed. However, for almost all cases, in traditional project financing lenders will not accept any risk that the technology… that produces the product… that generates the cash flow… that repays the loan…and that results in a return on investment, will be unable to perform consistently in a commercial setting, and to commercial standards.

Today's project financing typically involves the creation of a stand-alone project company, sometimes called a special purpose vehicle ("SPV") which is the legal owner of the project assets, and which has contractual agreements with a number of other parties, such as purchasers of the products ("off-takers"), suppliers, lenders, investors, sponsors, operators, equipment suppliers, insurers and firms that engineer, procure and construct ("EPC") the project.

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[2] See for example, Michael Ware's and Ed Feo's presentations At the 16th NREL Industry Growth Forum at : **http://www.nrel.gov/technologytransfer/entrepreneurs/16_forum_results.html**

Because of the impact of project risks on the ability to finance projects, the technology employed, and the project model (e.g. Distributed Generation, or merchant power), and the key parties all need to have successful track records that show that the risks are minimal. Consequently, project financing, with a debt and an equity component, is not an option for financing R&D or other "pre-commercial" projects. The challenge confronting the proponents of clean and renewable energy sources involves figuring out how to secure debt and equity for projects that are earlier on the path to full commercialization than sources of project financing are currently accustomed to.

The Importance of Project Financing for Clean Energy Technology Deployment

Project financing is often the only way that energy technology companies can "cross the chasm"[3] and move their products from early adopter customers to mainstream customers.[4] More specifically, the successful commercialization of an energy technology (and the success of the company manufacturing it, and its venture capital and government funding sources) hinges on the ability to secure project financing for its "early commercial" deployment.

Typically, neither the manufacturer nor the purchaser can self-finance, nor are typically either able or willing to secure financing using their balance sheets (non-project assets). Thus, either the manufacturer or the purchasers of its product must find a way to attract an affordable combination of debt, equity, and other sources of funding for the project. Moreover, the traditional source of early-stage energy technology financing is not available or appropriate for project financing. Consider that:

- The public sector, which has invested a considerable amount of taxpayer money in these technologies – primarily in R&D - is typically not appropriate as a source of project financing, per the public sector (especially federal) mission mandates, nor are the funds that are available adequate for such large scale deployment efforts. Yet, the ultimate availability of project financing is quite important to public sector goals, since it is often on the critical path to large scale deployment of these technologies. Also, the technology investment made by the public sector has the potential to lie fallow if this financing is not available later, or at a minimum, the benefits that may otherwise accrue from the public sector investment will be delayed significantly.

- In the private sector, the traditional source of energy technology financing - venture capital - is too expensive to use for financing the deployment of a company's products. Thus the purchaser (the project), requires a significant amount of debt financing to purchase the energy technology in addition to the equity financing which in turn is key to creditworthiness.[5] Examples include: an ethanol plant using new biomass conversion technology, an apartment building that is installing water metering equipment, a large landfill that wants to deploy Stirling engines to generate electricity from methane, or a fleet manager that wants to convert delivery trucks to hybrid drive systems.

  Further since, venture capital investors seek a clear path to commercialization, the availability of project financing is extremely important to obtaining the original venture financing as well as enabling follow-on investment to occur at less expensive pricing.

[3] See for example Moore (1999)
[4] Ibid.
[5] There are other issues with venture capital as well. For instance, the rate of return that VC's can attain from projects, even when financing a small portion of the project, is often not sufficiently attractive. Probably the biggest issue though, is the exit strategy; for projects this is because there is often not a clear path to the liquidity event, and project lengths are too long for many of the VC's time horizons, especially if they have to wait until the debt is paid off.

Key Challenges Involved in Financing Energy Technology Projects

Most of the challenges faced in financing energy technology projects arise out of an immutable law of financing—low-cost (and fixed rate) private funding is only available to commensurately low-risk projects.

In this context it is important to remember that:

- Many renewable energy projects generate less cash flow than comparable fossil fuel-fired projects because they can only operate when the renewable resource is available.[6] The sun only shines for 10 hours a day. The resulting lower cash flows provide lower margins for project financing and tend to put more pressure on costs associated with overhead and maintenance. This also can be mitigated by larger project size and remote monitoring.
- Because of low margins, high administrative costs, and technology and market risk premiums, it is especially important that renewable energy projects take advantage of all appropriate tax benefits and incentives, and that they be monetized effectively in the project financing plan, and in a way that credit risk is minimized.[7]

In addition to risk it is also important to be cognizant of other issues within the larger context of today's project financing industry. For instance size, scale, and transaction cost issues are often central to effectively structuring financing for clean energy projects.

Further, even where projects use proven conventional technologies, recent over-supply of electric capacity from merchant power plants have made project financing in the deregulated electric market very difficult to obtain; especially the debt portion. Moreover restructuring in the utility industry has resulted in other challenges; e.g. the credit worthiness of utilities that agree to purchase the power from projects cannot always be assumed to be good a-priori, and in cases where transmission and generation resources have been de-bundled, access to the transmission can be an issue.

We discuss some of the key reasons why clean energy technology based projects are in particular deemed inherently risky by potential private funding sources below.

Risks

As noted above, risk affects the amount, timing, and availability of funds for project financing. Hence the management of all risks (including technology and market risk[8]) is crucial in every project financing effort, and successful project structuring is largely about identifying, mitigating and sharing risks, which is accomplished primarily through contractual agreements. Moreover:

- Debt financing is typically much lower in cost and thus more risk averse than equity financing. However, risk limits the size of the loan, shortens the term and increases the rate.
- Equity financiers tend to discount their valuation in order to account for risk. This is accomplished by increasing their targeted internal rate of return.
- Venture capital investment in early stage companies will be compromised or simply unavailable if project financing is likely to be problematic.

[6] There are exceptions of course; e.g. power quality, and some remote and portable power applications.
[7] See Appendix I for a brief summary on some of the key incentives and green markets, and some key corresponding web sites.
[8] See Finnerty (1996, pp 40-50) for a description of various project risks.

- Each technology will have a different risk profile; e.g. wind projects using widely used wind turbines may be considered to have virtually no technical risk (though it does have a resource-availability risk), but a first or second of its kind biomass to ethanol plant will have significant perceived technical risk (though little or no resource-availability risk).

Some of the key risks for projects, especially those using clean energy technology are described below.

Technology Risk

Technology risk is the most basic of the risks which project investors worry about, and it must be addressed effectively as a prerequisite to any dialogue with lenders and investors. Technological risk exists when the technology, on the scale proposed for the project, may not perform according to specifications over the entire life of the project, or will become prematurely obsolete. Technical obsolescence becomes particularly important when a project involves a state-of-the-art technology in an industry whose technology is rapidly evolving.

The key challenge with many clean energy technologies is that there is often no information on "comparables"[9], an experience base or track record in the marketplace that is needed for due diligence and risk assessment by the project financiers. Hence, technology risk for a new product (with little commercial evaluation or marketplace experience) that is manufactured by an early-stage company (that presumably has no credit track record) is inherently inconsistent with project financing. As one Growth Forum panelist said, "project finance and technology risk are different topics in the same sentence."

Technology risk has proven to be a particularly thorny issue with the 1st or 2nd plants employing newer technology that carry somewhat higher costs because of their innovative and less mature nature. Such plants include those corresponding to a range of innovative renewable technologies for power plants (e.g. some wind farms using newer turbine designs), for manufacturing facilities (e.g. a PV plant), and for processing facilities (e.g. an ethanol plant).

Finally entrepreneurs and the sponsoring public sector investors can often interpret technology risk differently than investors or lenders, since a significant amount of the technology risk is already greatly reduced through public sector sponsored R&D programs and first and second round venture financings. An entrepreneur that has progressed through a working bench model, an alpha test, and a pilot-scale site that seems to be working, often feels that this is sufficient to push for commercialization. Not so for project lenders who typically want to see well documented technical verification and acceptance in the marketplace. This suggests the need for a financing bridge between beta and commercial products, a form of high-yield project financing for early-stage commercial products. This also suggests that there is a need to develop a shared mindset on technology and other risks by all the involved participants.

Creditworthiness

Per Finnerty (1996), a project has no operating history at the time of its initial debt financing (unless its construction was financed on an equity basis and the project debt financing funds out some portion of the construction financing). Consequently, the amount of debt the project can raise is a function of the project's expected capacity to service debt from project cash flow—or, more simply, its credit strength. In general, a project's credit strength derives from (1) the inherent value of the assets included in the project, (2) the expected profitability of the project, (3) the amount of equity that project sponsors have at risk (after the debt financing is

[9] Data from comparable projects on which risk estimates can be made are typically used by investors.

completed), and, indirectly, (4) the pledges of creditworthy third parties or sponsors involved in the project.

With many projects based on clean energy technology, especially with relatively new technology, creditworthiness is typically a big issue. Very often the relatively new, clean energy technology not only lacks sufficient testing and verification, it also lacks sufficient acceptance in the marketplace, and it is manufactured by an early-stage company. Further, the typical early stage company often has a weak balance sheet and presumably has no credit track record. This credit issue is compounded when the start-up company manufactures the technology and acts as the project owner (in such cases the project is de facto the company[10]). This again clearly points to the need for a financing bridge between working models of the technology and commercial products and the associated project financing.

Revenue Security

Once you get past the technology risk, there are additional risks that the financial community is not willing to take. The most formidable, according to the Massachusetts Renewable Trust (the Trust)[11] is the need for revenue security over the period of time required to pay back the capital investment. Because renewables tend to be so capital intensive, most of the costs must be amortized upfront over a long period of time if debt is to become available. For example, 15 years is a common requirement in New England.

There are a number of innovative financial engineering approaches such as the “put” option approach that the Mass Trust that has developed. We will discuss these more below in the section on ***Financial Innovation***.

Market Competition Risk

Clean and renewable energy technology projects often have higher capital costs than projects utilizing traditional power generation technologies. This can make them more difficult to finance to the extent that their revenues are limited by the price of electricity (this price is based on the cost of producing it using the cheaper traditional technologies, (unless government intervenes; e.g. through Renewable Portfolio Standards (RPS)).[12] Furthermore, funding sources sometimes see this as indicating that the technology will become extinct; thus posing a risk that the project in question will have difficulty performing/generating sufficient revenues for the term of the financing. On the other hand, especially if the technology does not utilize a feedstock that must be purchased, the full life cycle costs of the project may be competitive or superior to a traditional alternative whose revenues are sensitive to feedstock costs.

Over time, the capital costs of these projects will become more competitive as costs of manufacturing drop due to increased production/decrease in per unit cost, and the cost of project development (including costs of securing financing) drop through learning and standardization.

Opportunities Relative to Risk

With respect to risk, it is important for project and other financiers to:

[10] Hence in a real sense the viability of the first major one or two projects represents the viability of the company.
[11] Karlynn Cory (2004). Massachusetts Technology Collaborative. private communication.
[12] See Appendix I

- Know the hurdles that energy technology entrepreneurs are dealing with in the market. There is a need to stay current on state of the technology, what customers and consultants are actually saying, and think creatively about how to accept later-stage technology risks.
- Inform developers about the most strenuous tests that you will put them through before writing checks.
- Share information about putting risk management in the proper hands, and at the proper stage of project development. For example, work with companies to identify, and allocate risks to those entities that are able to mitigate each specific risk. The way risk sharing is allocated today, contractual agreements are very important in risk mitigation
- Be willing to accept loan guarantees from third parties (and maybe even from venture capital investors) that fall away when the project meets the test of technology commercialization or when the market risk has been mitigated by a minimum throughput or minimum sales level.

Finally, based on the discussion above, we emphasize the need to develop a place in the company's capital structure between venture capital financing and (traditional) project financing.

Scale and Related Cost Issues

Size matters. Distributed generation ("DG") projects using renewable energy are typically smaller than large infrastructure projects that tend to dominate the project financing industry today. This should be evident since DG is meant to be smaller, located nearer to the customer and therefore not requiring costly transmission and distribution ("T&D") infrastructure. Large projects have a competitive advantage because they can absorb large due diligence and transaction costs. With the small size of many renewable energy projects, due diligence and transaction costs can make the cost of project financing prohibitive.

Opportunities Related to Scale and Other Cost Issues

For scale issues - one answer is to develop "cookie cutter" project financing documentation that might have a high initial transaction cost for the first project but would have lower costs for subsequent projects because lenders are willing to accept uniform documentation. Due diligence costs will naturally reduce over time as lenders become more familiar with renewable energy projects. In addition, it may be possible in some cases to bundle multiple projects, having dissimilar risk characteristics, together into a portfolio of projects that has lower risk characteristics than any single project.

Further Opportunities for Enhancing Project Financing Feasibility and Availability

We have discussed a few of the opportunities to deal more effectively with risk and scale issues, some of which are already being implemented to a limited extent – yet we clearly have addressed only the tip of the iceberg. In particular, additional areas that seem to offer significant opportunities for successfully addressing the challenges in obtaining project financing include:

Developing a Shared Understanding of the Financing Needs of Participants

First, entrepreneurs must meet the requirements of financiers, especially with respect to risks such as those related to technology and markets, or the private and public sector will not finance their projects. Financiers cannot be expected to change the way they do business (this is true for both debt lenders and equity investors). Hence, understanding the needs of public and private sector financiers is a required first step in developing a more effective working relationship among entrepreneurs, lenders and investors.

Second, financiers can benefit, and thereby help increase the yield on their investments and loan portfolios if they also develop a better understanding of early-stage energy technologies and their inherent risk profile, and integrate this understanding into their project lending and investment criteria early on. This can be accomplished by (1) involving themselves in the planning stage of energy technology projects prior to the time that the company is seeking financing, (2) seek to better understand the underlying technology risk and the project specific issues for that particular project versus the tendency to bundle all projects as inherently risky because they are new and disruptive, (3) organize a briefing for their credit committees and commitment committees which would cover issues specific to advanced and renewable energy projects including those covered in this Summary, and (4) actively participate in energy technology venues such as the NREL Industry Growth Forums.

Financial Innovation

Innovation is important. It was clear from the 16th NREL Industry Growth Forum project finance case studies that the successful entrepreneurial companies had to be quite innovative and creative in obtaining their project financing.[13] Each affirmed the importance of addressing all of the prerequisite risk-related issues of project financiers. From the diversity of approaches, it is clear that there are no silver bullets when it comes to project financing, as no universal roadmap exists. The public sector however, can play an important role in this area as seen below.

Recent innovations in finance, including currency futures, options, interest rate swaps and caps, and currency swaps, have provided project sponsors with new vehicles for managing certain types of project-related risks more cost-effectively.

For example (Bolgen, Nills, Cory, Karlynn S., and Sheingold, Barry J. 2004) the Massachusetts Renewable Trust (the "Trust") has developed an option approach whereby the Trust provides the project owner a financial "**put**" option that guarantees a certain minimum price level at which the energy from the plant can be sold. For example suppose the Trust guarantees that a project will be able to sell its output for $0.10/KWH. If the project plant can sell its output into a market that pays $0.12/KWH, then the **put** is worth nothing to the project owner, and the Trust pays nothing to the project. On the other hand if in a fluctuating market, the project can only sell its energy for .08/KWH, then the **put** option owned by the project requires that the "Trust" pay .02/KWH to the project owner, thus insulating the project from the risk of fluctuating energy costs (it is also capped in terms of total revenue for each specific project). The Trust has developed other variations on the **put** option called **collars** and **put-backs** as well.

How risk is allocated among the participants, including the use of insurance from non traditional sources can likely play a significant role in all of these areas. Some ideas include:

- Shared savings contracts like the Federal Energy Management Program (FEMP)
- Fall-away loan guarantees
- Subordinated debt
- Innovative development and use of new insurance products
- Look at ways to lower the risks to equity investors,[14] and attract venture capital along with other co-investment (see below).

[13] For example see Appendix II for a short description of the BC International case study presented at the 16th NREL Industry Growth Forum which describes the project financing challenges which they had to overcome.

[14] Though, equity investors can benefit from the leverage derivable from using lower cost debt financing (see Appendix 4), many venture (not all) investors often sill will not consider project equity investments for the reasons stated above; e.g. returns are too low, and the exit strategy is not sufficiently well defined.

In addition to the innovations in financial engineering, new organizations that engage additional players are being developed. These include organizations that:

- Engage philanthropic organizations in co-investment, using both debt and equity, for projects.
- Raise venture funds focused on providing the equity portion for projects, which is often as difficult as the debt; the availability of the equity portion directly enhances the creditworthiness of the project.
- Public sector investment in for-profit funds such as In-Q-Tel, and Milcom that syndicate investment with a number of private sector funds.[15] Both of these funds, using a "dual use" philosophy, aim to accelerate the development and commercialization of technologies that support their respective missions while building more effective working relations with private sector businesses and financiers – the co-investors leverage not only the financing from other funds, they also leverage their insights on due diligence, and markets.

Learning from the Past

Sharing and learning from what has worked before is obvious, but sharing and understanding what has not worked is even more important. Case studies that summarize the relevant experiences can be quite helpful in this regard. Very little has been done to date in this arena although there are some case studies available.[16]

These case studies can help to expand information on new innovations from a number of perspectives, and to inform public policy experts that many energy technologies have actually made it to the commercial marketplace. Such case studies could also help to inform and provide a baseline for public policy experts for their new initiatives, as they increasingly become more engaged in the important issues around clean energy technologies.

Moreover, by engaging the premier MBA programs in the associated assessments, the objectivity, and creativity of the these top flight University programs, as well as increased credibility for the results and recommendations can be leveraged.

[15] See Murphy and Edwards (2003). pp 33, 34
[16] For example see Appendix III: Learning from the Past – The Luz Experience.

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Additional Presentations and Papers to be posted on the site (all will be in PDF format):

- **Edwin F. Feo, Milbank Tweed Hadley & McCloy LLP,** Partner – The Fundamentals of Project Finance. NREL Industry Growth Forum, Austin, TX, November 17-19, 2003. http://www.nrel.gov/technologytransfer/entrepreneurs/pdfs/16_proj_finance.pdf
- **Jerome P. Peters, United Capital, Senior Vice President** – Financing Ventures in the Renewable Energy Arena: CBI's 5th Annual Financing U.S. Power Conference. (file)
- **John McKenna, Hamilton Clark & Co. -** Financing Energy Technologies: From Technology to Projects. For the NREL Project Finance Study Group. April 2004. (file)
- **Michael Ware, Black Emerald Capital**, Managing Director - Project Finance: Past, Present, and Future. NREL Industry Growth Forum: Special Project Finance Session, Austin, TX, November 17-19, 2003. http://www.nrel.gov/technologytransfer/entrepreneurs/pdfs/16th_project_finance.pdf
- **Daniel P. Goldman, New Energy Capital, LLC,** Managing Director – Renewable Energy Project Development and Financing – Opportunities and Constraints in the New Energy Environment. Financing Renewable Energy Projects Center for Business Intelligence, Denver, June 23/24, 2003. (not yet available)
- **Karlynn Cory, Massachusetts Technology Collaborative Renewable Energy Trust, Policy Associate** – Long-Term Revenue Support to Help Developers Secure Project Fnancing. Windpower 2004, American Wind Energy Association, March 31, 2004. (file)
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- See Project Financing Session at the 16th NREL Industry Growth Forum. See http://www.nrel.gov/technologytransfer/entrepreneurs/16_forum_results.html - for the key topics discussed and the results and go to the bottom of the page for the project finance section, and start with : http://www.nrel.gov/technologytransfer/entrepreneurs/pdfs/16_proj_finance_overview.pdf

Appendix I - SBC's, RPS's, REC's and Green Markets

Because of all the issues described above in this summary report regarding risk, and cost effectiveness, it is important to monetize all the potential benefits provided to, and for, clean energy projects that can help make them more economically viable. These benefits include a range of federal and state tax credits, and as well as those benefits that can accrue from Green markets (GM's), System Benefit Charges (SBC's), Renewable Portfolio Standards (RPS's), and Renewable Energy Credits (REC's).

- Green markets have developed around the (now well founded) assumption that a growing population of people want to purchase green power and are also willing to pay a certain premium to get that green power. There are a number of green marketing companies that have emerged both regionally and nationally to take advantage of this market opportunity. Green markets complement the public policy driven RPS and SBC's.
- RPS's require that a certain percentage of clean energy power be generated by power producers over a specified time frame in the local regions in which the RPS applies; e.g. TX has a strong RPS. The prices paid for renewable energy under an RPS can vary depending on supply/demand balances and resource availability in particular regions.
- SBC's impose a fee on electricity customers to be spent on clean energy projects / investments; CA for instance has a very strong SBC's program – which supports a good deal of effort at the California Energy Commission. SBC funds are often used to provide incentives for project developers or rebates for customers purchasing small renewable systems. SBC funds can also be used to provide incentives for developing green markets, and fostering entrepreneurship, as well as in educating potential users on the opportunities within these markets.
- REC's allow the environmental attributes from a project to be grouped together to form a separate commodity that can then be traded independently from the underlying electricity. REC trading maximizes the potential value of a renewable generation project because it allows the market to allocate the RECs and electricity to the buyers that value them most. The ability to sell the two commodities independently permits greater flexibility in forward contracts, and REC's can be used to demonstrate compliance with a corresponding RPS, and they can be used as "currency" in green markets as well as in emission trading markets.

Unfortunately the availability of these opportunities (the accessibility of the renewable resource not withstanding) varies widely across the country, and so a project that is attractive in one geographical or deregulated region may not be attractive in another region. To help address this dilemma excellent information on these opportunities can be found at Green Power Network located at : http://www.eere.energy.gov/greenpower/home.shtml . Further, maps showing the status of various deregulation programs and green pricing programs are located at the following:

- http://www.eere.energy.gov/greenpower/dereg_map.html and
- http://www.eere.energy.gov/greenpower/pricing_map.html

On the subject of REC's, there are some excellent references; see for example:

  - Center for Resource Solutions. Regulators Handbook on Tradable Renewable Certificates, San Francisco, California, 2003. http://www.resource-solutions.org/RegulatorHandbook.htm

- Giovinetto, A. "On the Track of Green Certificates," Environmental Finance, September 2003. http://www.evomarkets.com/assets/articles/ef9RECs_rep.pdf
- Holt, E. "Renewable Energy Certificates and Generation Attributes," *Issuesletter*, Regulatory Assistance Project, Gardiner, Maine, May 2003. http://www.raponline.org/Pubs/IssueLtr/RenewableEnergyCertificates.pdf

Appendix II: Case Study - BC INTERNATIONAL CORPORATION[17]

Company Description: BC International is a privately held company based in Dedham, Massachusetts. We apply our landmark patented and proprietary biotechnology to produce ethanol from cellulosic biomass (such as bagasse, rice straw, corn stover, and forest thinnings). BCI's technology achieves high ethanol yields at low cost (waste feedstock, location advantages), and BCI's process is more advanced than those of its biomass-to-ethanol competitors.

The technology has been demonstrated in two pilot plants. BCI plans to expand its business through the ownership and operation of ethanol production facilities, joint ventures and domestic and international licensing of its technology. BCI is currently developing its first plant in Louisiana, using bagasse as a feedstock, and its next two plants in northern California, using rice straw and wood wastes. BCI also has a technology transfer arrangement with Marubeni for the application of its technology in Asia.

Key Project/Asset Equipment: BCI's first industrial-scale facility will be located in south central Louisiana. This facility will process bagasse (sugarcane residue) from local sugar mills to produce 30 million gallons per year of ethanol. The ethanol will be sold primarily to fuel marketers and oil companies serving the East Coast, Texas and Louisiana.

Key Challenges: The three main interrelated challenges are: (i) funding the parent company while simultaneously (ii) pursuing closure of the project financing of not only a single project (which always has project specific issues), but (iii) one which is the "first-of-its-kind" in its field – it includes a new technology.

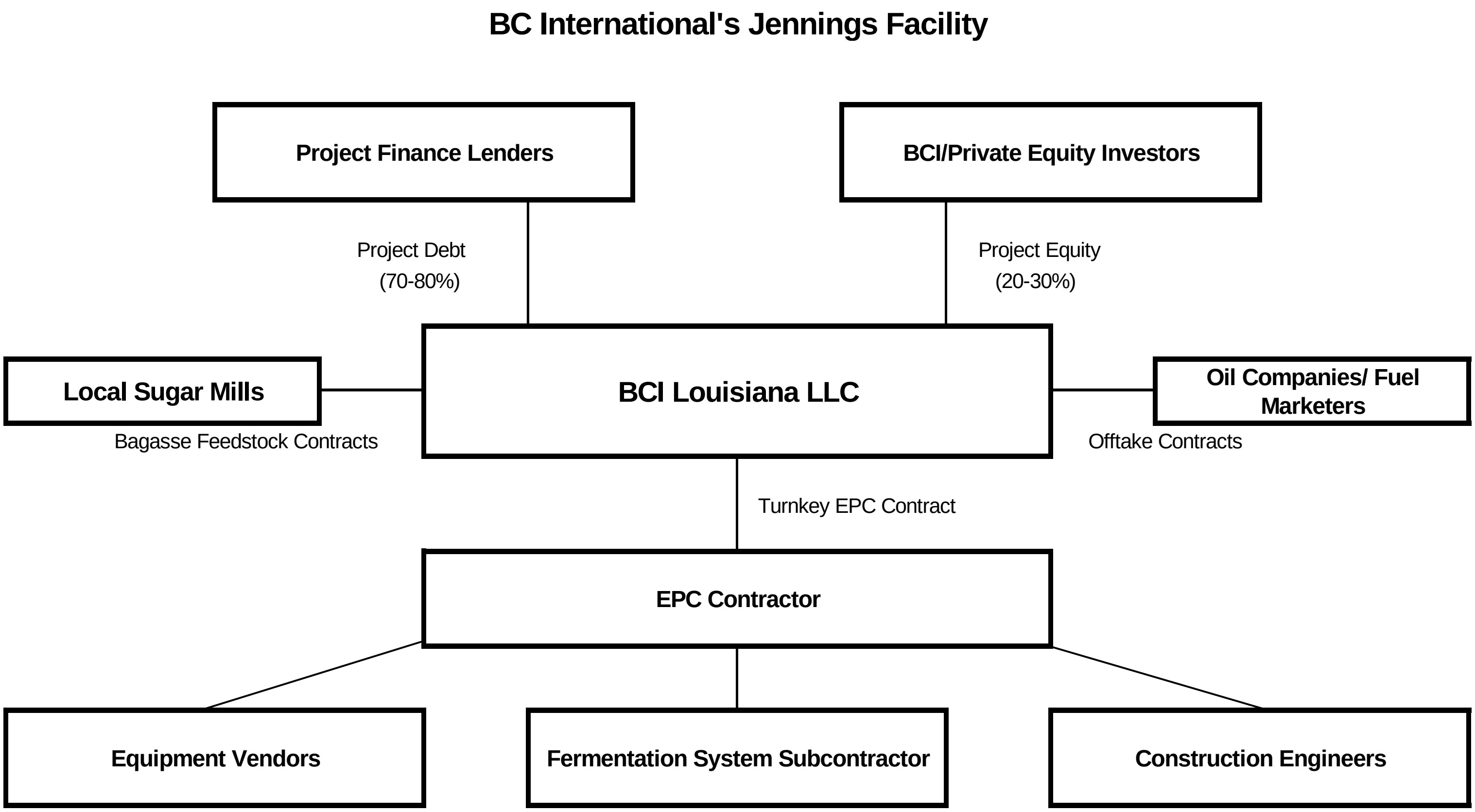
Challenges have been exacerbated by: (a) the biotech/energy divide, (b) being both a "high tech" and "low tech" company, (iii) the divide between corporate and project equity investors (although we can use either corporate or project money to fund the project), (iv) the desire of corporate investors for a 'first mover' advantage vs. the desire of project investors for successful precedents, and (v) only the downside from government actions (legislative or regulatory changes) is apparently possible.

Notwithstanding 3+ years of successful pilot plant performance and almost 50 patents, we need to show that returns from the first plant are at market and that large entities stand behind performance. (In practice, the tech platform and "learning curve" effects should result in lower capital and operating costs for subsequent plants.)

Key Approaches Utilized: Many approaches have been tried over the years (tax-exempt debt//private placement /private equity/complicated EPC contract with financial holdbacks). The problem has been equity more than debt. We are currently organizing a world-class group of three major contractors/subcontractors to collectively provide sole-source turnkey credit support for construction. With this construction group we expect substantial cost improvement as well as further substantiation of our credibility and the market opportunity for the pending $8.4 million corporate equity raise. A portion of these funds will pay for engineering necessary for the EPC contract and other project-specific arrangements (feedstock, offtake, licenses, etc.).

[17] Presented and discussed at the 16th NREL Industry Growth Forum.

Example Diagram:



Appendix III: Learning from the Past – The Luz Experience

http://www.eia.doe.gov/cneaf/solar.renewables/renewable.energy.annual/backgrnd/ch11box.htm

The Luz Experience

In 1984, Luz International built its first Solar Electric Generating System (SEGS) plant and immediately became the world leader in solar power generation. Luz put eight more plants into operation over a period of less than 7 years. A number of factors contributed to its success: tax credits, a quick move up the experience curve, the ability to provide bulk power, and several market factors, including expectations of rising natural gas prices and high avoided-cost rates for utilities. Initially, the company received 25-percent Federal tax credits, which were matched by the State. As successive plants were built, costs decreased and performance increased (the first plant had an installed cost of $5,979 per kilowatt of capacity, compared with $3,011 per kilowatt for the ninth). Natural gas was used to supplement 25 percent of the solar generating capacity, so that plant output could be tailored to meet utility peaking requirements. And expectations of higher fossil fuel prices in the future made Luz's alternative energy projects more desirable. Yet Luz went bankrupt while constructing its 10th plant.

Although Luz relied heavily on tax credits and property tax exemptions to reduce costs, it was still fighting an uphill battle in some areas of tax equalization with conventional fuel power plants. Under most State tax codes, solar plants face heavier tax burdens than conventional fuel plants because their "fuel” supply and sourcing are the same. Most States treat solar collectors as capital equipment, with the solar field representing real property. Solar plants can thus incur both a recurring property tax liability and sales taxes on the purchase of equipment for plant construction. Because conventional fuel plants buy fuel directly and own no equipment to "create" the plant's fuel, they pay no property or sales taxes at the time a plant is built.

Luz was also hampered by changes in the tax codes that helped it become successful in the first place. The uncertainty associated with the continuation of beneficial State and Federal tax policies added to construction risk and increased the cost of financing. This type of uncertainty in various aspects of the solar energy industry continues today, and it continues to add risk to commercial solar development.

While uncertainty in tax policy and the elimination of tax credits contributed to Luz's downfall, its financial failure can also be attributed to changing forces and price expectations in the electric power market. As natural gas prices fell in the late 1980s, utilities' short-run avoided costs for new electricity generation also fell. As a result, it became more difficult to finance new SEGS projects, and in the end Luz simply could not compete with the continuing decline of natural gas prices.

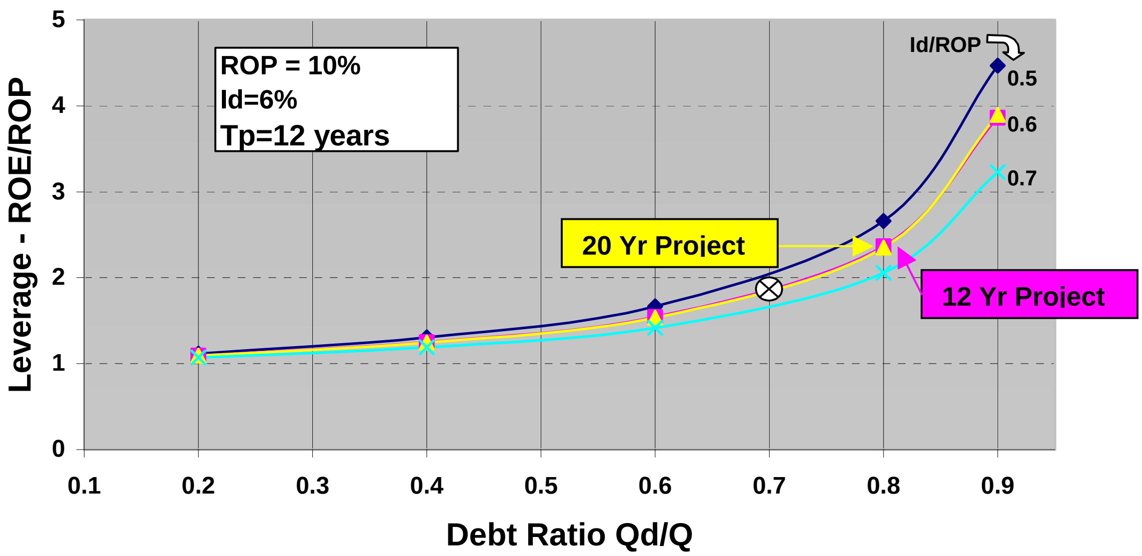
See also:
http://www.eere.energy.gov/troughnet/pdfs/parabolic_trough.pdf
http://www.eere.energy.gov/troughnet/plant_experience.html

Appendix IV: Equity Investors Can Benefit By Leveraging Lower Cost Debt Financing

The potential leverage that an equity investor might gain relative to debt financing can be particularly attractive to equity investors – positive leverage will exist if part of the investment can be financed with debt that requires an interest rate that is lower than the return based on what the project can generate from the resulting project revenues. In this case the higher the amount that is debt financed, the greater will be the leverage for the equity investor. However, a project developer typically can't just walk into a bank (or other lender) and get debt financing for the whole project, since lenders want to share the risk as discussed above in the main body of the report. One way to share the risk, add more credibility, and to help keep the project on track is to require that a certain portion of the project be equity financed. And the equity investor can in turn, benefit handsomely on well founded projects, as discussed by way of example next.

Consider a simple example, without regard for tax, depreciation, post debt resale of the project, or salvage; and also assume that the project is 12 years of length (Tp), with a total project investment of Q. Also assume that the project generates revenues such that a 10% return on the total project investment (ROP) over a 12 year period results. In this case this means that the project generates revenues of 0.1468*Q annually.

To see the kind of leverage that is possible, also assume that 70% of the total project cost (Q) can be financed with debt (Qd=0.7*Q), which can be borrowed at a debt interest rate (debt interest rate =Id) of 6%, while the remaining 30% of the project investment must be an equity investment. In this case the annual debt payment will be .0835*Q, leaving the annual cash flow to the equity investor of .0633*Q. Calculating the rate of return on the equity portion of the investment (ROE) shows that there is significant leverage for this case; the equity investment will return a little over 18.27%, which is 3X Id, and about 1.8X ROP. See Figure 1 below to see how the return on (ROE) the equity portion of the investment will change with variations on a number of parameters.



Normalized Leverage (ROE/ROP) On The Equity Portion Of The Project Investment As A Function Of Debt Ratio (Qd/Q) For Several Values Of Ratios Of Interest On Debt / Return On The Project (Id/ROP)

For the base line case described above and marked by $\otimes$ in the figure, the leverage that the investor gains for a number of scenarios is shown. It is seen that leverage is strongly related to debt ratio (Qd/Q) but somewhat less on the ratio of debt interest to the return on the project (Id/ROP).

Also in the above figure, and for comparison purposes we have plotted an additional curve corresponding to a 20 year project[18] for an Id/ROP of 0.6. It is seen that there is little detectable difference between the 20 (yellow) and 12 (magenta) year project cases. Thus leverage shows little dependence on project length for the range of cases considered here.

Finally, a quick rule of thumb, for the range of parameters that we have been considering, the leverage ratio (ROE /ROP) can be estimated by the following:

Approximation …….ROE/ROP = 1+ (1-Id/ROP)*(Qd/Q)/(1-Qd/Q)

This approximation, which can be easily derived based on very long projects is seen to be independent of project length; but even so, for projects in the 12 year length range and for the range of cases that we have been investigating, it provides a reasonably good estimate. In the Table below we show the calculated values ROE/ROP for the 12 and 20 project cases along with the approximation given above.

Comparison of ROE/ROP vs Qd/Q for 12, and 20 Yr Projects, as well as Approximate Solution from Above Equation (ROP=10%; Id/ROP=.6)

Qd/Q	0.200	0.400	0.600	0.800
12 Yr Proj.	1.095	1.249	1.544	2.366
20 Yr Proj.	1.093	1.245	1.535	2.351
Approx Sol.	1.100	1.267	1.600	2.600

[18] We used the same value for the ROP of 10% for both the 12 and 20 year project. For the 12 year project to generate a 10% ROP, annual project revenues of about 14.68% of the total project cost are needed. Correspondingly, for a 20 year project life, 11.75% of total project investment is needed annually.